LETTERS TO THE EDITOR.

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Magnetic Strain in Bismuth.

YOUR report of the meeting of the Royal Society of Edinburgh, held on May 16 (NATURE, June 22, p. 192), states that Dr. C. G. Knott has obtained a slight indication that there is a change of form in bismuth when strongly magnetised.

In the *Phil. Trans.*, vol. clxxix. (1888) A, p. 216, I described an experiment in which a rod of bismuth was found to exhibit an elongation of about 1·5 ten-millionths of its length in a magnetic field of 840 C.G.S. units. As to the reality of this effect and the fact that it was due solely to magnetism, there was no doubt whatever.

Since the publication of my paper I have repeated the experiment with another sample of bismuth obtained from Messrs. Johnson and Matthey; but though the field was brought up to nearly 1500 units, there was never the smallest indication of any magnetic change of length. An elongation one-tenth as great as that observed in the former case would have been easily perceptible.

After this experience I should hesitate to attach importance to any such observations unless the bismuth employed had been proved by analysis to be free from traces of magnetisable metals.

SHELFORD BIDWELL.

MY experiments were made with a bismuth *tube*, the notion being that, as in like experiments with nickel tubes, any existing strain would be much more easily detected by means of secondary volume changes than by means of the direct elongation measurements which Mr. Bidwell so successfully carried out. Mr. Bidwell's warning as to the necessity of having the material pure is well-timed. So far I have taken no special precautions in this direction; but in the improved form in which I purpose repeating the experiment, and from which I hope to get some really decisive result, this question of freedom from traces of strongly magnetic metals must of course be carefully considered.

C. G. KNOTT.

Gooseberry Saw-fly.

I SHALL be obliged if any reader of NATURE who has happened to pay attention to the gooseberry saw-fly will let me know whether my experience agrees with that of observers in other parts of the country. In Yorkshire the larvæ were so abundant in 1893, 1894 and 1895, that the bushes were in many places stripped of their leaves every summer. In 1896, there was a marked diminution, and many of the larvæ contained ichneumons. In 1897, 1898 and 1899, they have been so scarce that I have had difficulty in getting specimens for anatomical study.

L. C. MIALL.

The Yorkshire College, Leeds, June 29.

School Laboratory Plans.

REFERRING to Mr. Richardson's letter (p. 199), our laboratory, now approaching completion, will afford, as regards chemistry in a room 30 by 26 feet, accommodation for twenty-seven boys, including one 18-foot bench for general purposes, and two draught cupboards. We have one 21-foot wall bench and two 18-foot double central benches in parallel, and one 10-foot wall bench at right angles. I believe a novel feature to be the demonstrator's platform placed on the top of and slung across the central benches, provided with a revolving chair and a table, and approached by steps. The whole sacrifices two working places only. The demonstrator has sixteen boys in front of him, five parallel with him, and six behind him, at a maximum distance of fifteen feet. His commanding position should save considerable time usually spent in running about. A large mirror might further aid matters. The central benches alone have reagent shelves.

A. E. MUNBY.

Felsted School, Essex.

ILLUSTRATIONS OF MIMICRY AND COMMON WARNING COLOURS IN BUTTERFLIES.

AN interesting, though brief, paper entitled "Natural Selection in the Lepidoptera" was read by Mr. Mark L. Sykes before the Manchester Microscopical Society on November 4, 1897, and published in the *Transactions* for the year (p. 54). The chief interest of the paper consists, as the author points out, in the eight excellent plates by which it is accompanied. These plates contain a very large number of figures reproduced by a photo-mechanical process from the insects themselves. The author has evidently had at his disposal a very large and complete collection, and having selected a number of very fine illustrations he thus makes them available for all other naturalists.

At the opening of his paper the writer expresses some doubt as to whether the subject is a suitable one for a Microscopical Society; but on this question there need be no hesitation. The microscope is an instrument of the most varied uses, and is necessary in the investigation of this subject among others, for without its aid we cannot ascertain the depth to which mimetic resemblance penetrates into the structure of organisms. The interpretation of these resemblances as due to natural selection implies that they are confined to visible effects, and therefore the microscope should reveal an underlying difference beneath the superficial similarity. Hence a paper which, by describing this fascinating subject, and abundantly illustrating it, directs attention to a promising field for microscopic inquiry, is in every way suitable for the audience before which it was read, and the Manchester Society is to be congratulated upon the broad view it has taken of its subject and responsibilities. The present writer has already commenced the study of mimetic resemblance from this point of view, and has found that the methods by which the transparency which is necessary for the likeness attained in a group of Lepidoptera from South America differ in the most marked degree, although the superficial resemblance is of a very high order (*Journ. Linn. Soc.*, vol. xxvi., 1898, pp. 596–602; plates 42, 43, 44).

The great interest of Mr. Sykes' paper is the abundant illustration which it provides for the two different classes of resemblance often confused together under the name of "Mimicry." A few words on the history of the recognition and suggested explanation of these two classes may be useful, inasmuch as great confusion still exists upon the subject. The theory of mimicry was first suggested by H. W. Bates in his important paper published in the *Transactions* of the Linnean Society for 1862 (vol. xxiii.). He here suggested the idea of a conspicuous, abundant, and specially defended species, serving as the model towards which other comparatively rare and defenceless species are brought by natural selection. His illustrations were taken from the fauna of tropical America, and the explanation was suggested to him by the study of his collection after his return home from his prolonged visit to the Amazon Valley. The theory is of special interest, as it was probably the first great result of the theory of natural selection after its appearance in the *Journal* of the Linnean Society in 1858, and in the "Origin of Species" in 1859. Bates' generalisation was extended by A. R. Wallace to the tropical East (*Trans. Linn. Soc.*, 1866, vol. xxv.), and by Roland Trimen to Africa (*Trans. Linn. Soc.*, 1870, vol. xxxi.). In the first-named paper Bates expressly pointed out that his explanation did not cover all cases of mimetic resemblance, but that there were a very large number of species abundant in individuals, and presumably specially defended, which nevertheless "mimic" each other. Furthermore, this kind of resemblance is as close and detailed as that which the Batesian theory of mimicry sought to explain. For such

cases Bates could only suggest—and Wallace at first accepted the suggestion—that the likeness was produced by some unknown influence connected with locality. In some mysterious way the species were supposed to be made alike as a direct result of life in a common district. No further advance was made until 1879, when Fritz Müller suggested (*Kosmos*, May 1879, p. 100) that the resemblance between relatively unpalatable forms was advantageous in facilitating the education of their young and inexperienced enemies, thus preserving a large proportion of the individuals which would have been necessarily sacrificed if the "warning" pattern of each species were different from that of every other in the same locality. Prof. Meldola translated this paper (*Proc. Ent. Soc.*, Lond., 1879, p. xx.) and argued in favour of the explanation which Wallace also accepted. The same kind of likeness between specially protected forms was shown to exist in the tropical East by F. Moore (*Proc. Zool. Soc.*, 1883), and in Africa by the present writer (Report Brit. Association, 1897, p. 688).

The hypothesis associated with the name of H. W. Bates was believed by a large number of naturalists from the very first, while that due to Fritz Müller was a long time in making its way. Of recent years, however, it has come to the front, chiefly in consequence of the papers of F. A. Dixey (*Trans. Ent. Soc.*, Lond., 1894, 1896, 1897). In these papers Dixey has shown strong reasons for the belief that many examples formerly explained by the theory of Bates are in reality to be interpreted by that of Fritz Müller. The wonderful tropical American groups of remotely allied species with a common appearance, selected by W. F. H. Blandford, assisted by the late Osbert Salvin, from the great Godman-Salvin collection, and exhibited at the Royal Society (1896) and Entomological Society (1897), also tended to deepen the impression which the Müllerian theory was making. It was clear to every one who examined the various groups (lists of the species exhibited are given in *Proc. Ent. Soc.*, Lond., 1897) that the vast majority of the likenesses were between species which are known to be abundant and believed to be relatively unpalatable.

The great interest and value of Mr. Sykes' paper is given by the eight excellent plates which accompany it, reproducing many examples of Müllerian mimicry, and large numbers which are believed by the author and many others also to be still explicable by the theory of Bates. Their full discussion, as far as the facts at present known will allow, would be of great interest and would, in the opinion of the present writer, lead to the conclusion that a considerable proportion, at least, are more probably to be explained on Müllerian lines. The examples in the first two plates are almost without exception admitted to fall under the Müllerian theory, and they are described as "Mutual Protective Resemblance of Inedible Butterflies." All the examples are selected from tropical America, and supply a permanent record of many of the members of the groups selected by Blandford.

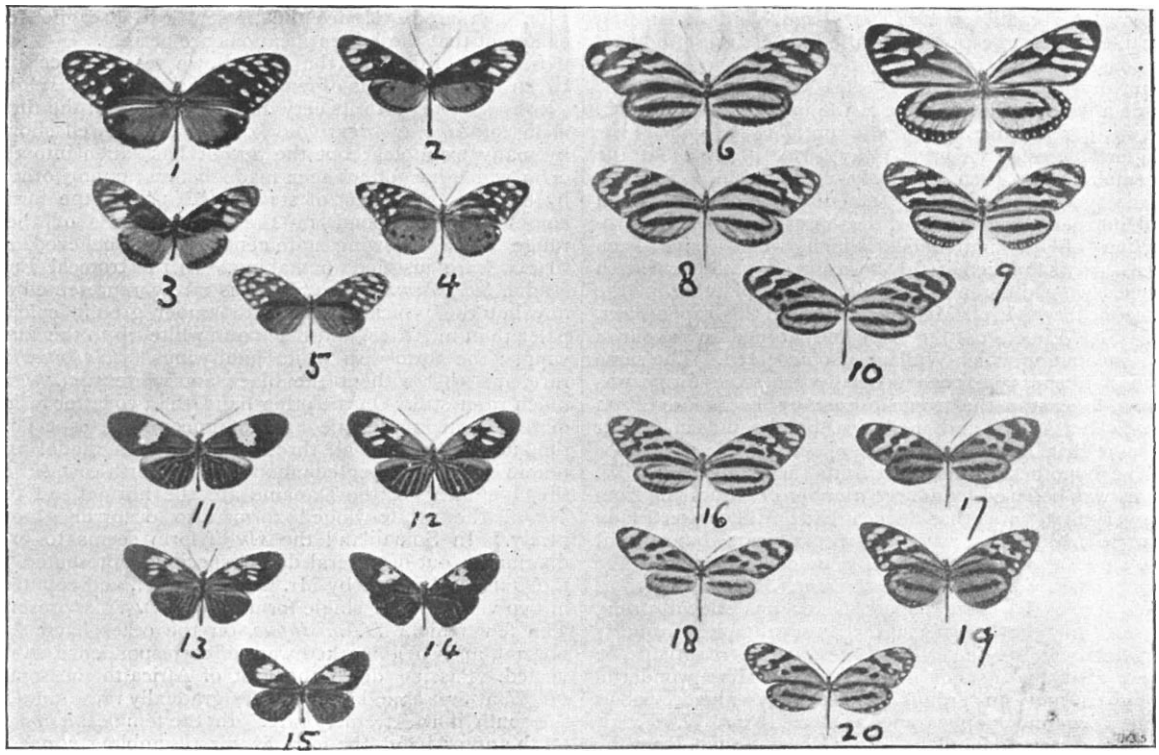
Plate II. is here reproduced, and will serve well to show the closeness of the likeness which is attained, as well as the composite nature of the groups. That containing Figures 6 to 10 is the most interesting in this respect, containing as it does representatives from three distinct subfamilies, all of which are believed to be unpalatable—the *Danainae*, *Ithomiinae* and *Heliconinae*. A few errors which have crept into the description of the figures have been set right in the present reprint. (Fig. 6 is that of *Heliconius telchinia*, not of *Eueides zorcaon*; *Eresia*, Fig. 15, belongs to the *Nymphalinae*, not the *Pierinae*.) The distinction between the *Ithomiinae* and *Danainae* is now generally recognised, and has been introduced. A few of the species, viz. those named in Figs. 3, 4, 11, 14, 15, 19, and 20, are insufficiently represented or altogether absent from the collection with which the plate has been compared. Hence the present writer cannot feel confident that these identifications are correct.

In the third plate the well-known resemblance between the three forms of female of *Hypolimnas misippus* (*Nymphalinae*), with its very different male, and the three forms of *Limnas chrysippus* (*Danainae*) are well shown by many examples; but the author has fallen into the error which has often been made before (among others by the present writer), of stating (p. 61) that the forms completely correspond in the various parts of their range. The following statement is, it is believed, all that we are justified in making. In the tropical East (India, &c.), *Limnas chrysippus* is rarely represented by any but the typical forms, with amber ground colour, paler than in Africa, and black and white tip to the forewings; the form with white hind-wings (*alcippoides*) is rare, and that without the black and white tip (*klugii*) much rarer still. On the other hand, the two latter forms of the mimicing female are not uncommon, especially the latter. At Aden all three forms of both model and mimic occur together commonly. In North-east Africa the chief forms of the Danaine are the normal and the *klugii*, the white-winged form also occurring more rarely. In Somaliland the *klugii* form seems to predominate; out of several dozen specimens presented to the Oxford Museum by Mr. C. V. A. Peel, and captured in two visits, not a single form except *klugii* is present. The few female *H. misippus*, on the other hand, are normal, and so a marked want of correspondence is revealed. Passing down the east of Africa to the south, *klugii*, at first abundant, becomes gradually rarer, until in the south it is extremely rare. In the female *misippus*, on the other hand, the form *inaria*, resembling *klugii*, is commonly intermingled with the typical form right down to the south. The white-hind-winged form of both model and mimic have a more parallel development occurring not uncommonly in both species. In tropical West Africa, on the contrary, the Danaine butterfly is always white-hind-winged, and the size of the white area is large (constituting true *alcippus*), while the very few females of *H. misippus* which I have seen from this part of the world were normal. Much more evidence is required before the relationship can be made out for all parts of the extremely wide range which these two species have in common. I have here set down the conclusions which seem to be warranted by the facts at present known, in the hope that others may be induced to publish, or at least to make their observations known to the present writer.

To summarise the facts set forth above, the varieties of *Limnas chrysippus* are more definitely restricted to certain localities than those of the female *Hypolimnas*, which is in all localities apt to be a more variable insect; furthermore, intermediate forms between the varieties are commoner in the latter than in the former. In the case of those localities where there is a marked restriction of the forms of *chrysippus* (Somaliland and tropical West Africa), there is no evidence of any equal restriction of the varieties of its mimic.

The figure of a white-hind-winged *alcippus*-like female *Hypolimnas* from Sierra Leone (Fig. 8) appears to have been taken from a not very perfect drawing, while all the other figures on all the plates are excellent reproductions from the specimens themselves.

In the brief but useful memoir which accompanies these plates, the principles of mimicry are described, and many of the figured examples alluded to. In describing the distribution of the varieties of *Limnas chrysippus* which has been here summarised, the author states that the uniformly coloured *dorippus* (*klugii*) is supposed to be the ancestral form. The immensely predominant mimicry of the type form by butterflies and moths belonging to all kinds of remotely allied groups, would, however, indicate with tolerable certainty that the type



MUTUAL PROTECTIVE RESEMBLANCE OF INEDIBLE BUTTERFLIES.

FIG.	1	2	6	7
SUB-FAM.	Heliconinæ.	Ithomiinæ.	Heliconinæ.	Danainæ.
GEN.	*Heliconius*	*Thyridia*	*Heliconius*	*Lycorea*
SP.	*zuleika* (Hew.).	*melantho* (Bates).	*telchinia* (Doubleday & Hew.).	*atergatis* (Doubleday & Hew.).
HABITAT	Central America.	S. and Cent. America.	Central America.	S. and Cent. America.
LOCALITY	Honduras.	Honduras.	Honduras.	Bogota.

FIG.	3	4	8	9
SUB-FAM.	Heliconinæ.	Ithomiinæ.	Ithomiinæ.	Heliconinæ.
GEN.	*Eueides*	*Tithorea*	*Melinaea*	*Eueides*
SP.	*thyana* (Feld.)	*irene* (Drury).	*imitata* (Bates).	*dynastes* (Feld.).
HABITAT	Central America.	Central America.	Central America.	Central America.
LOCALITY	Honduras.	Honduras.	Honduras.	Honduras.

FIG.	5	10
SUB-FAM.	Ithomiinæ.	Ithomiinæ.
GEN.	*Calithomia*	*Mechanitis*
SP.	*hezia* (Hew.).	*doryssus* (Bates).
HABITAT	Central America.	Central America.
LOCALITY	Honduras.	Honduras.

FIG.	11	12	16	17
SUB-FAM.	Heliconinæ.	Heliconinæ.	Ithomiinæ.	Ithomiinæ.
GEN.	*Heliconius*	*Heliconius*	*Melinaea*	*Mechanitis*
SP.	*venestus* (Salv.).	*vesta* (Cram.).	*lilis* (Doubleday & Hew.).	*veritabilis* (Butl.) (male).
HABITAT	South America.	South America.	South America.	South America.
LOCALITY	Bolivia.	Amazons.	Venezuela.	Trinidad Island.

FIG.	13	14	18	19
SUB-FAM.	Heliconinæ.	Heliconinæ.	Ithomiinæ.	Ithomiinæ.
GEN.	*Eueides*	*Eueides*	*Mechanitis*	*Tithorea*
SP.	*thales* (Cram.).	*heliconides* (Feld.).	*veritabilis* (Butl.) (female).	*doubledayi.*
HABITAT	South America.	South America.	South America.	South America.
LOCALITY	Amazons.	Bolivia.	Venezuela.	Venezuela.

FIG.	15	20
SUB-FAM.	Nymphalinæ.	Ithomiinæ.
GEN.	*Eresia*	*Ceratinia*
SP.	*cornelia.*	*dionaea* (Hew.).
HABITAT	South America.	South America.
LOCALITY	Bolivia.	Venezuela.

form is the ancestral one, just as the conclusion that Africa is the ancestral home of the species is justified by the predominant amount of mimicry of which *D. chrysippus* has been the attractive centre in this as compared with all other parts of its vast range. The time which would be necessary to bring about so deep an impression on so many diverse members of the surrounding insect fauna, justifies the view that the type form has persisted as it is for a very long period, and that it is an extremely ancient inhabitant of the country in which, far beyond all others, these effects are marked.

The statement on p. 61, that the varieties of the female *Hypolimnas misippus* are nowhere found "where the inedible *chrysippus* and its varieties do not occur," is an error. For many years now—certainly between twenty and thirty—the former species has been established in some of the West Indian islands and certain parts of tropical South America.

There are several errors in the spelling of names of species, and the figures in the plates are often wrongly sexed and sometimes wrongly named in the descriptions.

The doubtful points in the paper have been here discussed at some length, and errors of detail pointed out; but the present writer would wish in conclusion again to emphasise the interest of this short communication, and again to draw attention to the usefulness of the numerous illustrations. E. B. P.

THE UNITED STATES NATIONAL MUSEUM.[1]

THE last report issued by the U.S. National Museum furnishes abundant evidence of the energy with which America is now conducting scientific inquiry, and of the zeal with which she is augmenting the rich and varied collections preserved at Washington. Like most collections of the same character, the National Museum owes its origin to the generosity and enterprise of private individuals; and it was only after some years of precarious existence that it obtained due assistance and recognition from the State. The society organised in 1840, and called the "National Institute," may perhaps be regarded as the parent of the present Museum. Though prosperous during the first few years of its existence, it failed to interest a wide body of the public, and it was reserved for the Smithsonian Institution to obtain official recognition as the only lawful place of deposit for the national scientific collections. In 1846 such recognition was accorded by Act of Congress, and from that year until the present time the work of collecting and exhibiting new material has been carried on without interruption.

One striking characteristic which distinguishes the National Museum from similar institutions in other countries is to be found in the somewhat restricted area to which it has confined its attentions. While the museums of Europe include exhibits from all regions of the globe, the United States collections are, with a few exceptions, exclusively North American. The advantage of so restricting the area of research is obvious, for by this means the Museum has been enabled to attain an unrivalled completeness in the departments of science to which its energies have been devoted. The authorities have also found considerable assistance in the fact that for nearly twenty years they have received all collections of minerals and objects bearing on natural history archæology and ethnology which have been made during the numerous surveys undertaken by the Government of the United States.

The present report occupies over eleven hundred pages, and it would be impossible in a short notice to do more than sketch the general nature of its contents, and to indicate the sections into which it naturally falls. The volume is divided into two unequal parts, of which the first consists of the report of the late Mr. Brown Goode, assistant secretary of the Smithsonian Institution, to which are attached a number of appendices. This report covers the whole ground of the Museum's activities, describing new accessions, the arrangement and labelling of the collections, the work of exploration conducted during the year, the official publications and contributions made to scientific literature, and the work done in connection with visitors and students at the Museum. These general summaries are followed by detailed reports of the work done in the various scientific departments, concluding with the report of the administration department of the Museum. After a perusal of these reports it is evident that, in addition to prosecuting scientific inquiry, the Museum is doing much to render its resources available to the public at large. By its system of exchange and its distribution of duplicate specimens, a large number of local museums in the United States have benefited in the course of the year.

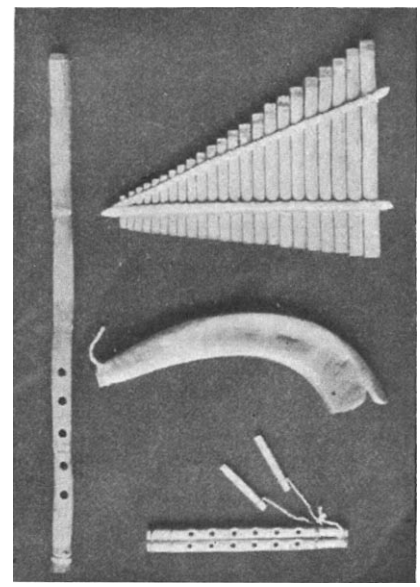


FIG. 1.—Wind Musical Instruments. 1, Reeds or Pan Pipes; 2, Ram's Horn; 3, Double Flute; 4, Flute.

The second and larger portion of the volume is of greater general interest, for it consists of a number of original papers describing and illustrating the collections preserved in the Museum. Of these, perhaps the most important is the paper on "Prehistoric Art" by Mr. Thomas Wilson, the curator of the Division of Prehistoric Archæology. Although in the main describing the specimens under his charge, Mr. Wilson has not confined himself to the art of primitive America, but has given a very exhaustive sketch of the products of early civilisations all over the world, and his essay forms a valuable contribution to the study of prehistoric man. Another interesting paper devoted to a special subject is contributed by Mr. Walter Hough, the assistant curator of the Division of Ethnology, who has written a monograph on "The Lamp of the Eskimo." The Museum possesses a very complete collection of Eskimo lamps, comprising examples used by nearly every tribe from Labrador to the Aleutian Islands. The lamps are

[1] Report of the United States National Museum under the direction of the Smithsonian Institution, for the year ending June 30, 1896. Pp. xxiv. + 1107. (Washington: Government Printing Office, 1898.)